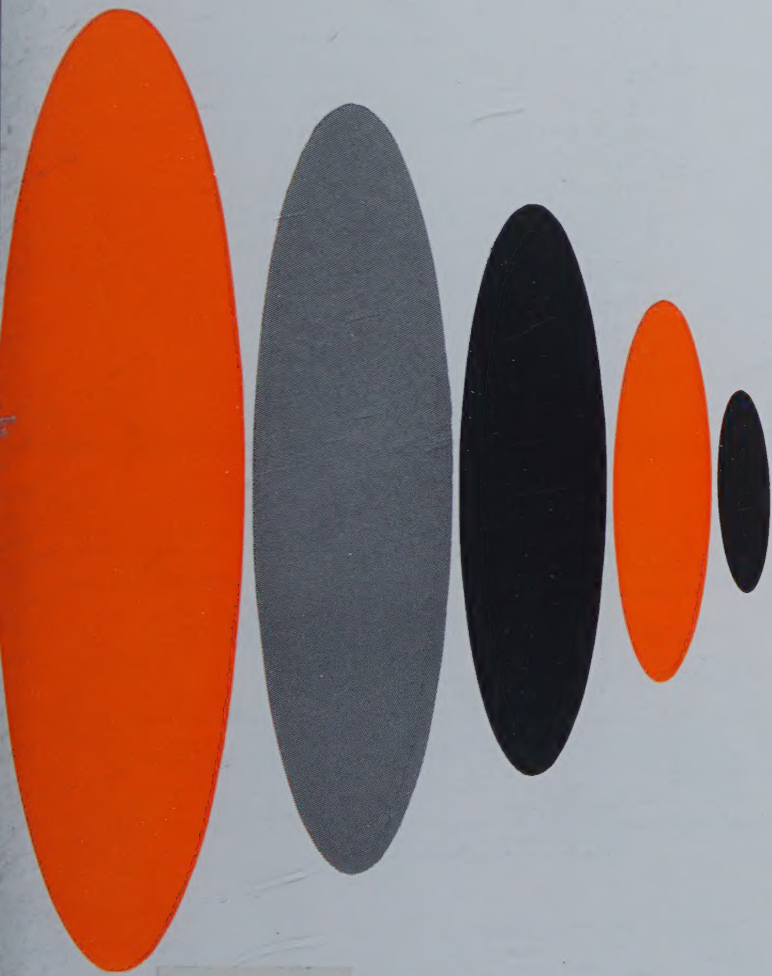
GRAPHIC SCIENCE



Ellipse Templates and Their Use

AUGUST, 1961

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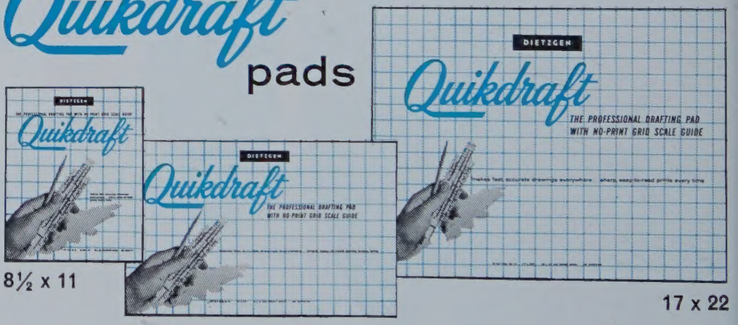

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GRAPHIC SCIENCE

AUGUST, 1961

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VOLUME 3 NUMBER 8

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Which Angle Projection?

Sirs:

Kudos on your magazine's last issue article about "British Versus American Projection." But the British first angle projection is secondary among our foreign problems. Of more direct concern to us is the rest-of-Europe's, Asia's, and South America's fourth angle or metric projection, also called German projection. It is particularly applicable in our growing Japanese business.

The attached copy of a memo I have just written on this problem may be of interest to your editorial staff. Your current article on the lesser of these two international problems deserves a follow-up article on the more major one. Your magazine is free to use any or all of the attached information, with or without credit, as you may choose.

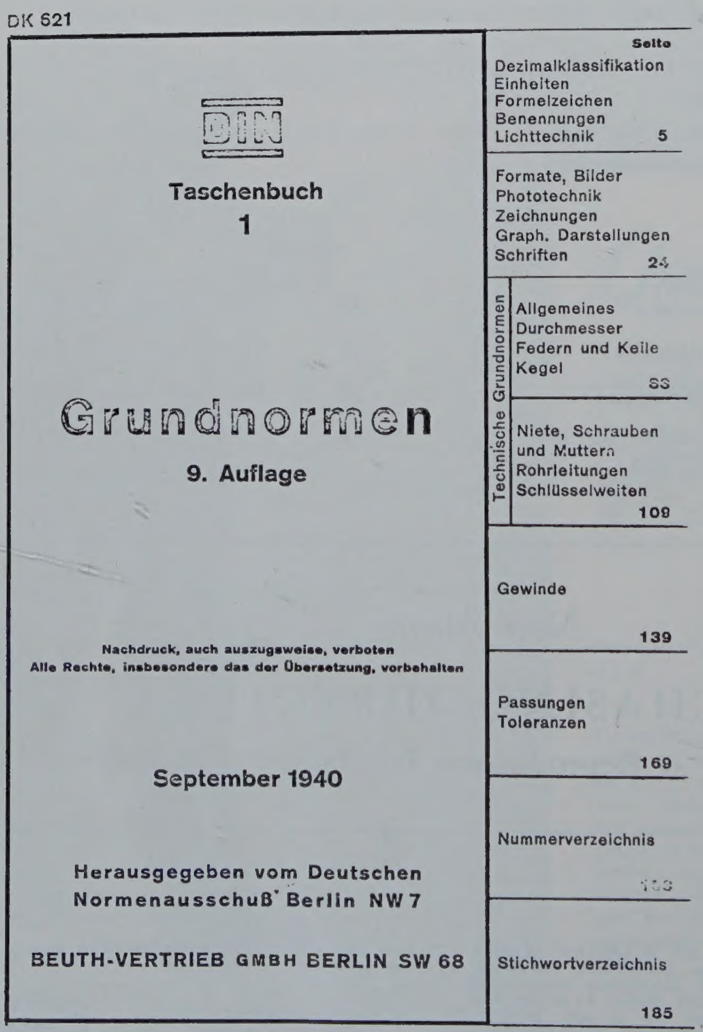
PAUL S. SMITH

Manager
Technical Information Service
Motorola, Inc.
9401 W. Grand Avenue
Franklin Park, Ill.

Inter-Office Memo from Paul Smith

Attached to your copy of this memo is a marked-up copy of the June, 1961, Graphic Science magazine. On pages 13 to 17 of this issue is an article on American versus British projection. In keeping with our recent discussions on drafting standards for foreign procurement drawings, this article points out a very important foreign versus American engineering drawing problem.

The new standard you issued in April on metric-to-inch conversion goes a long step towards helping us on that problem. But there is an almost as unsurmountable problem on how foreign drawings show their projections; that is, the relation of their front, top, bottom, left, right and back views. If not recognized and accommodated, as pointed out in this article, we certainly can get unusable parts from foreign sources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Taschenbuch
1

Grundnormen
9. Auflage

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September 1940

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Normenausschuß Berlin NW 7

BEUTH-VERTRIEB GMBH BERLIN SW 68

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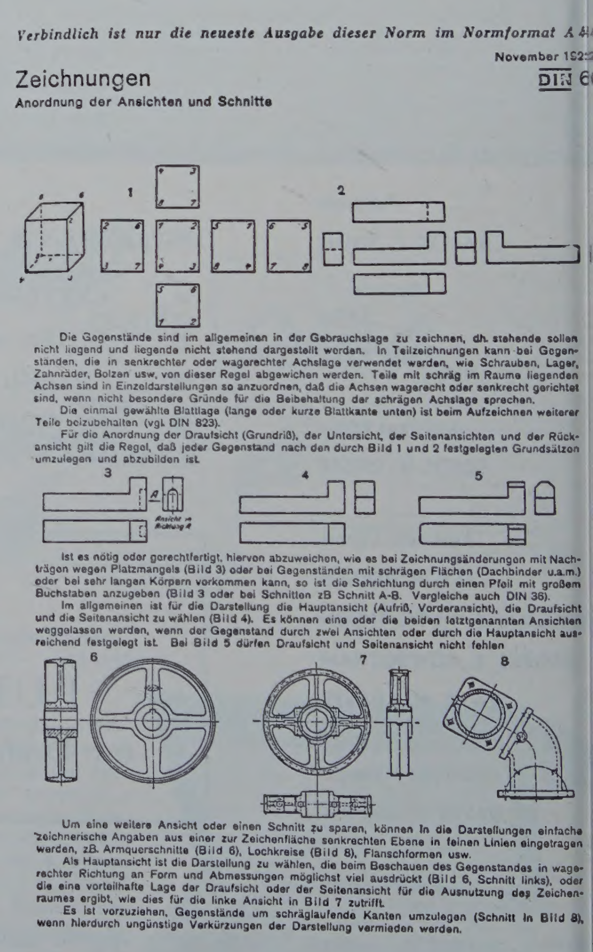
Verbindlich ist nur die neueste Ausgabe dieser Norm im Normformat A 4

November 192

Zeichnungen
Anordnung der Ansichten und Schnitte

DIN 6

Die Gegenstände sind im allgemeinen in der Gebrauchslage zu zeichnen, dh. stehende sollen nicht liegend und liegende nicht stehend dargestellt werden. In Teilzeichnungen kann bei Gegenständen, die in senkrechter oder wagerechter Achslage verwendet werden, wie Schrauben, Lager, Zahnräder, Bolzen usw, von dieser Regel abgewichen werden. Teile mit schräg im Raume liegenden Achsen sind in Einzeldarstellungen so anzuordnen, daß die Achsen wagerecht oder senkrecht gerichtet sind, wenn nicht besondere Gründe für die Beibehaltung der schrägen Achslage sprechen.

Die einmal gewählte Blattlage (lange oder kurze Blattkante unten) ist beim Aufzeichnen weiterer Teile beizubehalten (vgl. DIN 823).

Für die Anordnung der Draufsicht (Grundriß), der Untersicht, der Seitenansichten und der Rückansicht gilt die Regel, daß jeder Gegenstand nach den durch Bild 1 und 2 festgelegten Grundsätzen umzulegen und abzubilden ist.

Ist es nötig oder gerechtfertigt, hiervon abzuweichen, wie es bei Zeichnungsänderungen mit Nachträgen wegen Platzmangels (Bild 3) oder bei Gegenständen mit schrägen Flächen (Dachbinder u.a.m.) oder bei sehr langen Körpern vorkommen kann, so ist die Sehrichtung durch einen Pfeil mit großem Buchstaben anzugeben (Bild 3 oder bei Schnitten zB Schnitt A-B. Vergleiche auch DIN 36).

Im allgemeinen ist für die Darstellung die Hauptansicht (Aufriß, Vorderansicht), die Draufsicht und die Seitenansicht zu wählen (Bild 4). Es können eine oder die beiden letztgenannten Ansichten weggelassen werden, wenn der Gegenstand durch zwei Ansichten oder durch die Hauptansicht ausreichend festgelegt ist. Bei Bild 5 dürfen Draufsicht und Seitenansicht nicht fehlen

Um eine weitere Ansicht oder einen Schnitt zu sparen, können in die Darstellungen einfache zeichnerische Angaben aus einer zur Zeichenfläche senkrechten Ebene in feinen Linien eingetragen werden, zB. Armquerschnitte (Bild 6), Lochkreise (Bild 8), Flanschformen usw.

Als Hauptansicht ist die Darstellung zu wählen, die beim Beschauen des Gegenstandes in wagerechter Richtung an Form und Abmessungen möglichst viel ausdrückt (Bild 6, Schnitt links), oder die eine vorteilhafte Lage der Draufsicht oder der Seitenansicht für die Ausnutzung des Zeichenraumes ergibt, wie dies für die linke Ansicht in Bild 7 zutrifft.

Es ist vorzuziehen, Gegenstände um schräglaufende Kanten umzulegen (Schnitt in Bild 8), wenn hierdurch ungünstige Verkürzungen der Darstellung vermieden werden.

37

Our drafting standards on the so-
alled orthographic (or multiple-
iew) projection is based on the old
SA STD Z14.1-1935 as reissued in
946. The first version of our present
lrafting manual was issued in July
f 1944, during the war. Yours truly
vas coordinator. Its copy and figures
n projections are more complete
han our November 1958 (14 years
ater) drafting manual, because they
how how our American projections
vere developed.

In any case, the so-called Ameri-
an projection has become so second-
ature to us that we haven't needed
ny explanation on its development;
ntil we ran into this difference in
oreign projections. The old 1935-
946 ASA Standard has now been
uperseded by a new ASA Standard
14.3-1957, Section 3, on Projections.

Our 1958 drafting manual, Section
.4.4, pp. 2.14 to 2.18, concurs com-
letely with the new ASA Standard
xcept that we use the ASA-approved
ption of showing the back view on
he right, Fig. 2.16, instead of the
eft, as preferred in ASA Y14.3-1957,
ig. 2. Since this view is so seldom
sed, and is alternate ASA practice,
ve're okay in letting that option
tand. (It concurs with the Japanese/
etric practice).

But now comes the Graphic Sci-
nce (draftsman's) magazine com-
arison of our American projection
vith the completely different British
rojection. Without getting lost in
he descriptive geometry details,
vhich are much easier explained in
ictures than words, suffice it to say
hat the American projection is
ased on third angle (or quadrant)
iew of the object. This is also called
he glass box, transparent, or clear
iew projection. (And it is.) In this
rojection, the top is on top, the
ottom on the bottom, the right side
n the right, and the left on the left,
ommon-sense-wise.

Though the British are with us on
ch dimensioning, they're totally
ifferent on their engineering draw-
g projections. Their B.S. 308:1953
ngineering Drawing Practice Stand-
rd, Section 1 on Projections, as de-
ailed in the attached magazine arti-
le, uses the first angle (quadrant)
rojection. This is also called black
ox, opaque, or reversed view pro-
ection. (And that it is.) In this practice, the top is on the bottom, and the right is on the left!

Needless to say, this backwards British projection could cause us all kinds of trouble, if we didn't know, and label, which are the top and right sides of our British-imported record changers, for example. Anyhow, the primary point of the Graphic Science article is to inform American draftsmen, engineers, inspectors, and purchasing agents of this difference; and to help foster the now-in-transition conversion of the British practice to the American practice.

But that's not the primary purpose of *this* memo. What is of much more importance to us is, "What are the Japanese doing?" They, and all of the metric countries, that I've been able to determine, use the metric projection, or what we have been calling the German projection. This practice is outlined in the attached (to you) copy of page 37 of the German Standard DIN DK 621 Grundnormen 9 Auflage, 1940.

And what hurts is that any thought of changing all of these metric countries to the American clear view practice has about as much chance as changing them to inches, or us to pounds, shillings, and tuppence! So, what do we do? There's no choice. We'll continue to go our way with decimal-inches and clear view projection, and they'll go their's with millimeters and mixed view projection.

But that doesn't answer the problem of Japanese projection. So, considering your metric-to-inch conversion standard as a first step in this foreign problem program, the next obvious step is a similar supplementary (not drafting-manual-included) standard on metric-to-American orthographic projection conversion, with pictures, including the British projection difference.

Thank goodness that no one is using the second angle (or reversed vertical view only) projection; or we would have four practices to contend with. Anyhow, here's another standards problem, and what I think would be a sensible answer. (Though, like our inch-to-millimeter tables, this could be another Motorola first, it's not one we should publicize, beyond the people who need this information.)

Notes & Comment

Industrial Illustration

THE DIVISION of Applied Technology at Purdue University, West Lafayette, Indiana, has recently announced the scheduling of a new two-year program, "Industrial Illustration Technology," effective with the second semester of the 1961-62 school year. The course, which is believed to be the first of its kind in the United States, begins January 29, 1962, and will graduate its first students in 1964, with the degree of Associate in Applied Science.

The new curriculum comprises four semesters of college level courses in the following subjects: two semesters of English composition, one semester each of algebra, trigonometry, wood and metal working, physics, sociology, psychology, and production management, together with eleven courses of professional drawing and one semester of industrial sculpture.

The graduate should be able to take his place as a productive member of industry upon graduation. He will be trained as both draftsman and technical illustrator.

Consolidation

FOUR MAJOR FIRMS in the blue print and reproduction service industry in the Washington, D. C., area have consolidated. The new organization, to be known as Allied Blueprint Co., will be composed of Leet Brothers Co., Inc., Georgetown Reproductions, Inc., Blocher Blueprint & Supply Co., and Quick Print Inc.

Photogrammetry

THE NORTH ATLANTIC Region of the American Society of Photogrammetry will sponsor the society's Semi-Annual Convention and Technical Exhibit on October 4, 5, and 6, 1961 at the Biltmore Hotel in New York City. The emphasis of this meeting will be directed toward the more exotic aspects of photogrammetry, and will include the latest advancements in the basic engineering applications of photogrammetr principles. Technical papers will b presented and demonstrations will b held at the various equipment e hibits.

SES Annual Meeting

THEME of the tenth annual meetin of the Standards Engineers Soc ety, to be held September 18 throug 20, at the Hotel Sherman in Chicag is "Standards Equal Cost Reduction Among the interesting and valuab topics to be covered during the thre days: value analysis, federal stand ards, industry and military standar coordination, publication simplific tion, data retrieval, when standardi zation costs money, the standard engineer and the purchasing agent.

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RECENT PURCHASE of DataGraphi Inc., of Sunnyvale, Calif., is an nounced by Bofors Blueprint of Sa Jose, Calif. In addition to continuin the microfilming services of Dat Graphic, the firm will handle blu printing, printing, photocopying, an drafting supplies.

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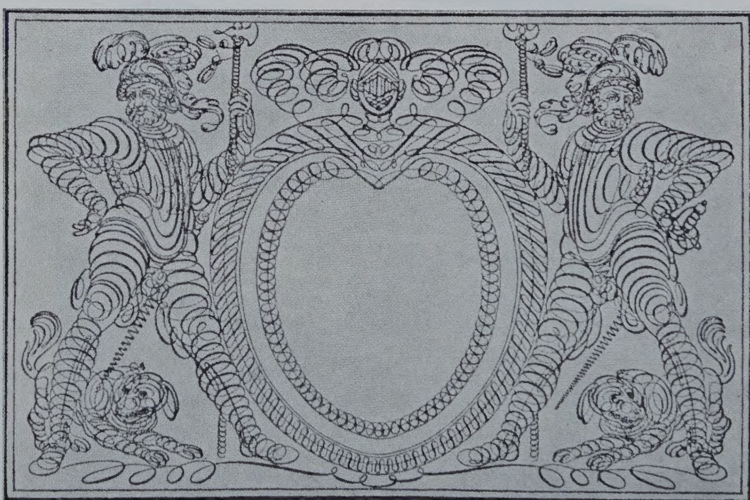
Types of Technical Drawings

by Franz Maria Feldhaus

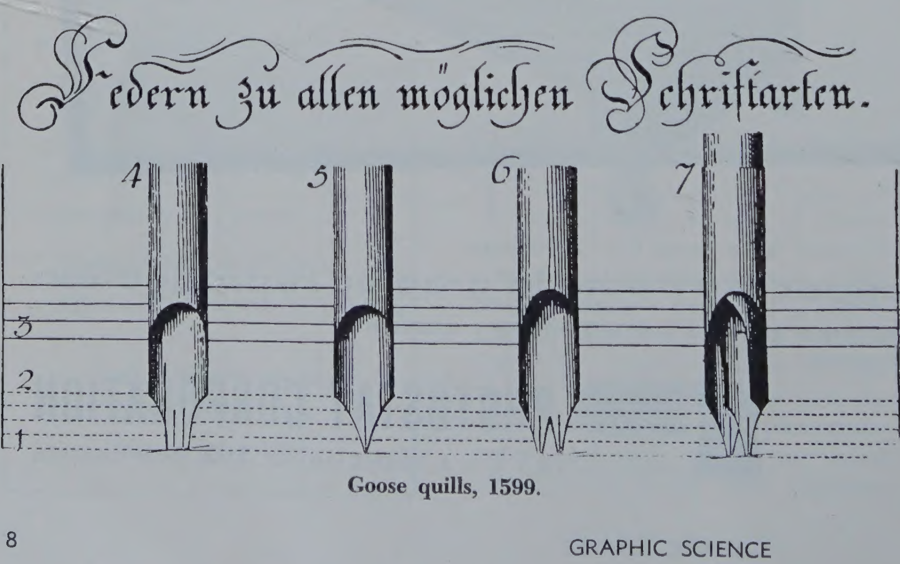
FERDINAND Graf von Veltheim drew, as a young mining official in 1759, the big copper mine of Falun in Sweden on nine pages which were cut so that one could see through cutouts into the very depth of the mine. The small flaps were so attached that one could also see the galleries lying at the rear. A Silesian drawing dating from 1788 has folding pictures to show the successive parts of a steam engine. The Berlin master builder David Gilly made the drawing for the reconstruction of the local city offices. Two of the pages have folding pictures to show the progress of work at various stages. The construction was difficult because they were building on marshy ground.

Technical drawings were beautifully finished once script writers developed the stiff monkish script into calligraphy. If one inscribed beautifully then one also had to draw cleanly and beautifully. Script developed very early into a round hand which was at that time called *ronde* in French. One wrote with blunt goose quills which gave broad and thin lines without pressure.

The first text on round hand was



Roundhand script dating from 1709



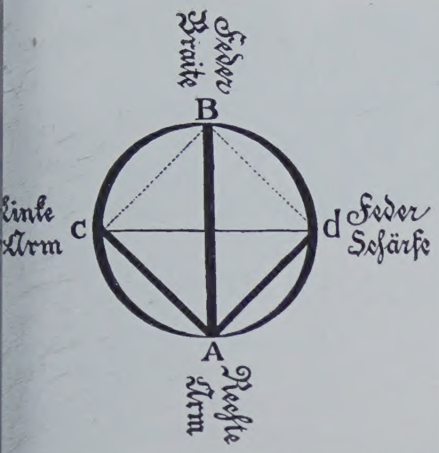
Goose quills, 1599.

This is a continuation of Chapter III of a authoritative and beautiful book, **THE HIS TORY OF TECHNICAL DRAWING,** by Fran Maria Feldhaus published in 1959 by Fran Kuhlmann, K.G., of Wilhelmshaven, German as **GESCHICHTE DES TECHNISCHEN ZEICH NENS.** We are indebted to the publisher fo the translation, as well as for permission t republish this fascinating work. It will be con tinued in this department from month t month, until completed.—The Editors.

called *La Technographie*. It was pub lished in 1599 by Guilleaume l Sangneur, secretary to the Roya Chancellory in Paris, and containe 87 large copper plates. It is assume that only one example was preserve with round-hand patterns of 4 pages—*Foundation of the Art o Writing*, by Johann Jacob Spreng preceptor at the school of writing an arithmetic of the gymnasium in Basle It appeared in 1709 and is toda kept in the library of the universit in Basle. The large *Encyclopédie* b Diderot and d'Alembert presente patterns in 1763 as well as writin utensils. This type of writing soo became outdated until the versatil technologist Franz Reuleaux and th manufacturer Friedrich Soennecke re-established it in 1875. The art o using stencils for inscriptions on draw ings developed slowly in other field and was later commonly accepted b draftsmen.

Stencils made of sheets of bronz that enabled the blind to write letter were described by the famous physi cian Geronimo Cardono as early a 1550. Brass stencils for markin laundry appeared in 1805 in Londo as something new. A little later Julie Leroy patented an apparatus in Pari that enabled him to write in th dark; he wrote between paralle rulers.

Unusual are the pictures draw with one continuous stroke of th pen that have been known sinc about 1608. The Patrician Zacharia Conrad von Uffenbach from Frank furt marvelled at a David which h had seen in Oxford in 1636 an which had been drawn in one stroke Related to these pictures are thos



A written drawing. Barocke Spielerei, 1640.

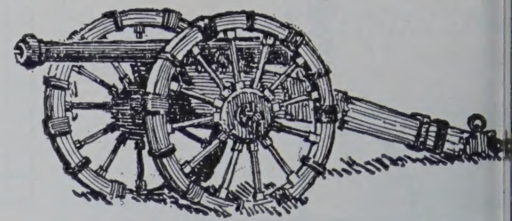
in which the line consists of very small rows of writing. In most cases the lines of clothes were done in this way and heads, hands, and feet were added afterwards.

At times mechanical draftsmen would stray into the field of architecture for one wanted to build machines beautifully and deck them with ornaments. A carpenter's bench completely covered with ornaments was presented to the Emperor Maximilian I in 1562 by a Tyrolean representative body. The wine crane in the Friday marketplace in Ghent was at that time richly ornamented. Albrecht Durer adorned the parts of mechanized wagons in 1526. Leonardo da Vinci, however, his oldest contemporary, fashioned machines without any ornamentation. When one was still ashamed of mechanization, anything technical was camouflaged. So a mill in the park of an estate about 1797 was externally fashioned like a church.

About 1802 it became the fashion in London to ornament shop windows in Gothic style. It seems to have pleased a Mr. Cragg so much that in 1813 he took out a patent for cast iron ornaments. This angered English engineers very much for they drew their machines in Gothic, Moorish, and Renaissance style. The curved and flourished stands which even today collect the dust on sewing machines date from that time. Ostentatiously overloaded with snaky ornaments is the Columbia book-printing press by George Clymer from the year 1817; on its top sits a large cast-iron eagle. England is also the home of castle-like bridges, built about 1900 because it was thought that only like that were they beautiful.

To Be Continued

Military Engineering Documentation



by W. S. Hutchinson

GRADES OF ENGINEERING DOCUMENTATION

THE SECOND meeting of the Defense Drawing Practice Industry Advisory Committee was held in Washington, D. C. on July 13, 1961. Herman C. Hangen, Director, Armed Forces Supply Support Center, welcomed the group, and stressed that the Center is vitally interested in all aspects of materiel management as achieving improved support means making maximum utilization of resources. The large dollar volume attached to the documenting of engineering data for the support of logistics operations, he said, motivates the Center to examine the methodology of acquiring, identifying, processing, and distributing the numerous forms of data included within the definition of technical or engineering data.

An American Ordnance Association proposal on "Grades of Engineering Documentation" was presented to the Industry Advisory Committee members for their consideration by W. W. Thomas, Administrator, Defense Electronics Products Documentation, Radio Corporation of America. This proposed specification would establish requirements for selection of documentation required for research and development and production contracts. It defines by statement of essential characteristics the completeness of documents required for those purposes. It applies to all military procurement of Engineering Data (Drawings, Specifications and Associated Reference Documents).

The proposal contains the following definitions:

Production Design—Production design is a design in which quantity production is contemplated without substantial redesign. For purposes of documentation requirements, production design includes service test, prototype, or production equipment.

Research and Development Design—R & D design is a design in which quantity production is not contemplated without substantial redesign. For the purposes of documentation requirements, R & D design includes experimental, breadboard, or developmental equipment.

Documents are divided into five grades in the proposal as follows:

Grade 1 Documents—Grade 1 Documents are those which are prepared in accordance with military specifications (MIL-D-70327 for drawings). They provide complete engineering information for the design evaluation, manufacture, inspection, maintenance, overhaul, installation, shipping, and storage of production design equipment.

Grade 2 Documents—Grade 2 Documents are those which are prepared to good commercial practices in accordance with requirements of Sections 5 and 6 of the proposed specification. (Sections 5 and 6 furnish both quantitative and qualitative requirements.) They provide complete engineering information for the design evaluation, manufacture, inspection, maintenance, overhaul, installation, shipping, and storage of production design equipment.

Grade 3 Documents—Grade 3 Documents are those which are prepared to military specifications in accordance with requirements of Section 5 and 6 of this specification. They provide adequate engineering information for the manufacture, inspection, maintenance, and installation of R & D equipment by the design contractor.

Grade 4 Documents—Grade 4 Documents are those which are prepared to commercial practices in accordance with requirements of Sections 5 and 6 of this specification. They provide adequate engineering information for the manufacture, inspection, maintenance, and installation of R & D equipment by the design contractor.

Grade 5 Documents—Grade 5 Documents consist of sketches, drawings, engineering notebook entries, or specifications for a design intended to prove the feasibility of a device, system, or principle. These documents are not subject to preparation in compliance with military specifications for material, procedures, or method of presentation.

The intended purpose of grading engineering documents is to distinguish the requirements of preparation to military specifications, both in terms of quantity of information and in quality of presentation. These elements would be governed, in turn, by the intended use of the document. More will be reported in future issues.

MIL-STD-1, GENERAL DRAWING PRACTICE FOR ENGINEERING DRAWINGS

Proposed Revision B is presently being circulated to industry for comments to incorporate recommendations for obtaining legible microreproduction of drawings.

MICROFILMING DOCUMENTS

Proposed revisions to MIL-STD-804, MIL-M-9868, MIL-C-9877, and MIL-C-9878 are currently being circulated to industry for comments to incorporate corrections and changes resulting from a year's experience. A new proposed specification for copy cards (aperture) will also be circulated shortly by the Signal Corps. A density step wedge standard and a densitometer specification are under preparation in the military series as well.

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GRAPHIC SCIENCE

AUGUST, 1961
VOLUME 3 NUMBER 8

Ellipse Templates and Their Use

Why most errors in technical illustration are the result of the incorrect use of ellipse templates

by T. A. Thomas

THE USE of the ellipse template in technical illustration is probably the most difficult problem to teach and the most difficult to understand. More errors are made in technical illustration because of the incorrect use of ellipse templates than for any other reason.

The purpose of the ellipse template is to represent circles or circular objects in three-dimensional drawing. There are other instances when the ellipse template is used, but they are of secondary importance at this time. The ellipse template is not meant to draw elliptical forms in technical illustration, as inexperienced users might think.

Knowledge of a few basic facts is necessary in order to discuss the ellipse template. First of all there are two parts to an ellipse: the minor axis or shortest diameter and the major axis or longest diameter (Fig. 1). Secondly, there are two general types of ellipse templates: the isometric ellipse template used only on isometric drawings, and the angle ellipse template used for nonisometric surfaces and for dimetric, trimetric, and perspective drawings. The angle ellipse templates are made for every five degrees from 15° through 60°.

The major difference between the two types of ellipse templates is the distance across the major axis (Fig. 2). The distance across the major axis of the isometric ellipse is greater than the diameter of the circle it represents, because an isometric drawing is about 1.22 times larger than a true three-dimensional view. For this reason the isometric ellipse marked 1″ is actually about 1.22″ across the major axis. The distance

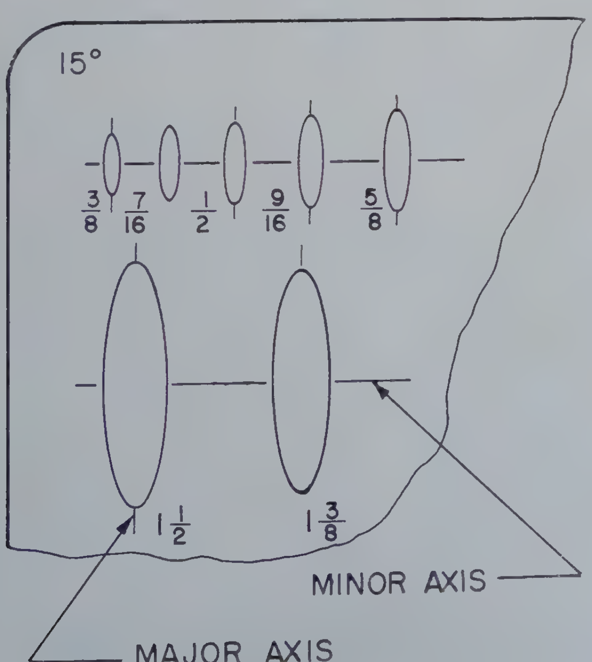


Fig. 1

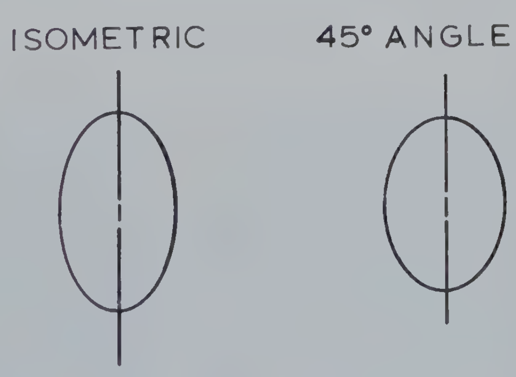


Fig. 2

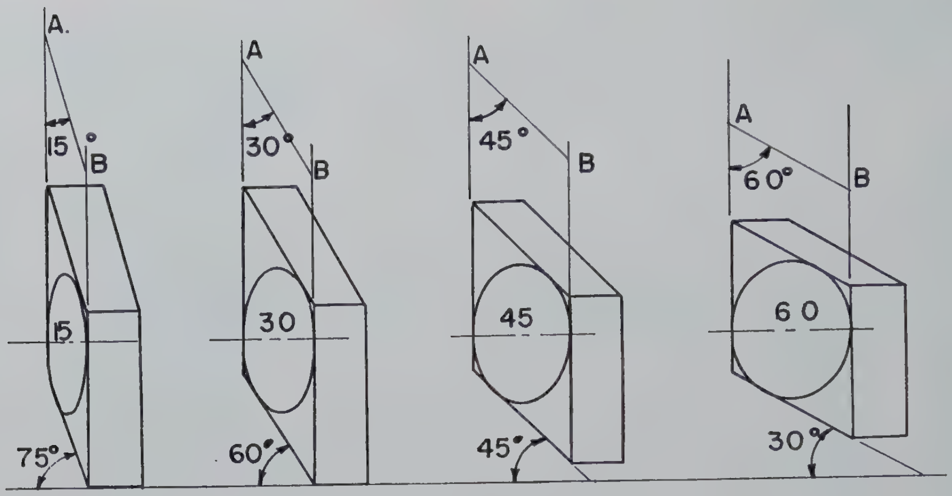


Fig. 3

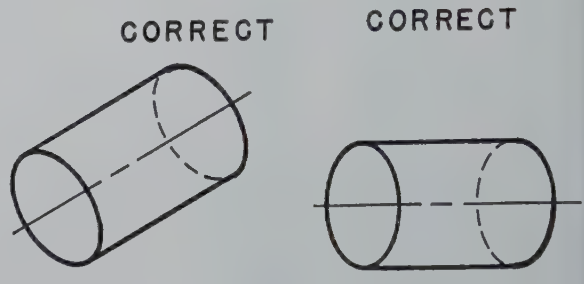


Fig. 5

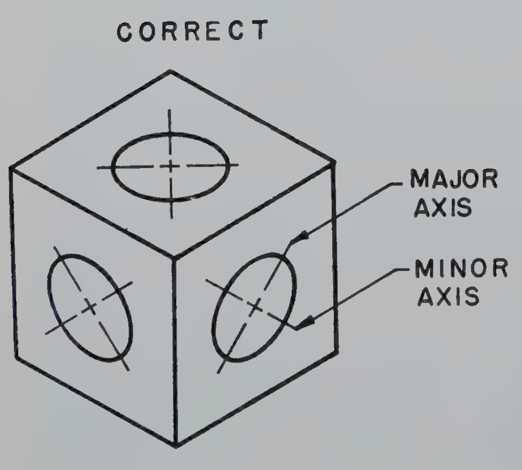


Fig. 4

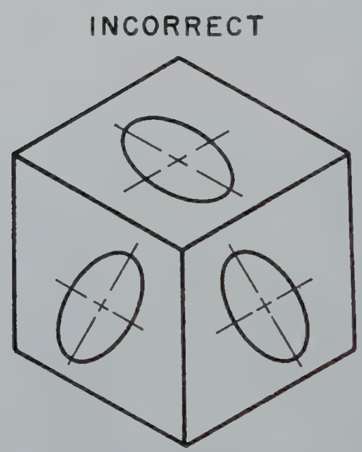


Fig. 6

across the major axis of any 1-inch angle ellipse is exactly equal to 1″. Some manufacturers do allow for the thickness of the pencil lead, however.

The distance across the minor axis of the angle ellipses vary with the angle size. For example, the distance across the minor axis of the 1″ 60° ellipse is greater than the minor axis of a 1″ 15° ellipse (Fig. 3). The distance across the minor axis of the isometric ellipse is equal approximately to .7 times the indicated diameter size of the ellipse.

With the above information clearly in mind we can consider the proper use of ellipse templates. The correct alignment of the ellipse is of primary importance; otherwise distortion will result. Always align the minor axis of the ellipse with the axis of the hole or shaft. The minor axis of the ellipse is always aligned with a line which *represents* a perpendicular to the plane of the surface on which the ellipse is drawn (Fig. 4). Fig. 5 shows the correct use of the ellipse when drawing a shaft. Improper alignment of the ellipse and the resulting distortion is shown in Figs. 6 and 7. It is always necessary to draw center lines in order to place the ellipse in the correct position, because a slight error in alignment may cause a great amount of distortion.

A simple isometric drawing showing the use of the two general types of ellipse templates is illustrated in Fig. 8. Surface X is an isometric surface, so the isometric ellipse was used. The axis of the hole is along the vertical line A-B, because this line *represents* a line that is perpendicular to surface X. Therefore the minor axis of the ellipse is aligned with this line. Surface Y is a nonisometric surface, so the isometric ellipse template cannot be used. Instead the proper angle-size ellipse must be determined. In this case it is a 45° ellipse. The axis of the hole

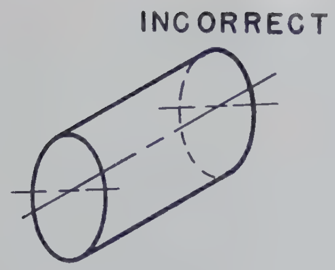


Fig. 7

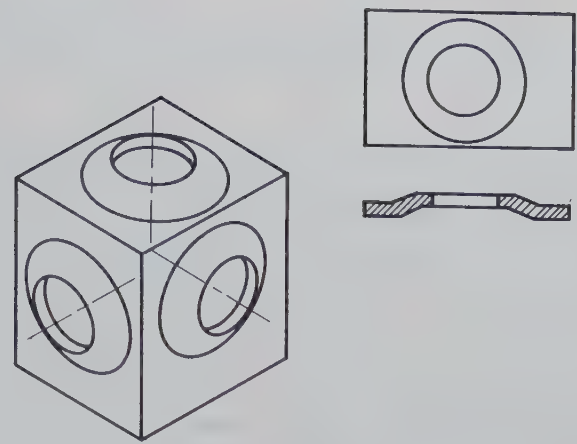


Fig. 10

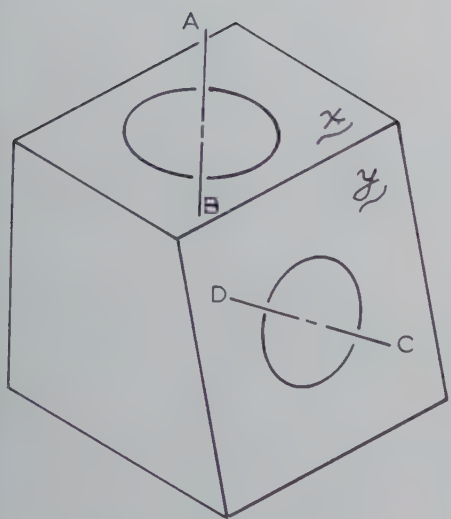


Fig. 8

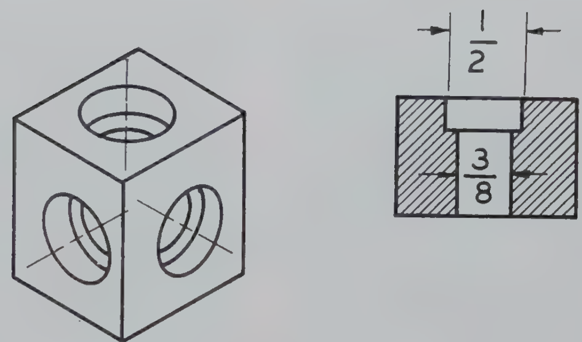


Fig. 11

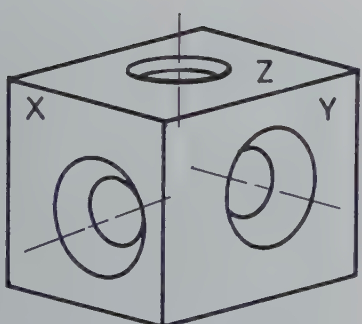


Fig. 9

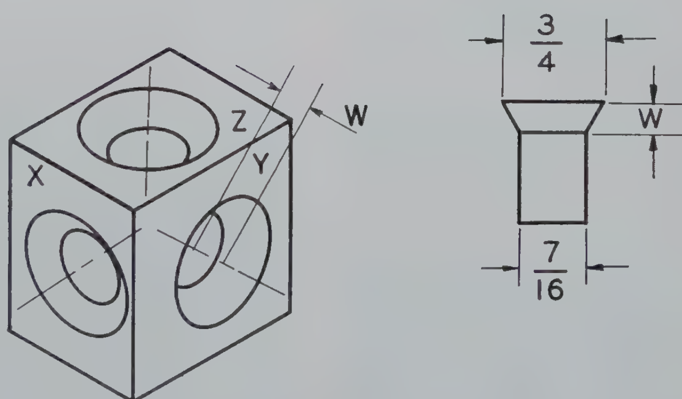


Fig. 12

s along line C-D since this line *rep-resents* a line that is perpendicular o surface Y. Therefore the minor axis of the 45° ellipse is aligned with ine C-D. If the hole on surface Y were not perpendicular to the sur-face, the ellipse could not be used, since the hole on the surface would be elliptical. Remember the ellipse s used to represent a circle or circu-ar objects, in technical illustration.*

The importance of finding the line that *represents* a perpendicular to the ellipse surface cannot be over-emphasized. Correct use of the el-lipse depends as much on this as on knowing what ellipse to use. Without the proper axis, the correct use of the ellipse would be impossi-ble. The proper axis for isometric drawings can be found with the use of an isometric protractor.

Other examples showing the use of the ellipse templates are shown in Figs. 9, 10, 11, and 12. There are many other instances where the el-lipse template is used, but a discus-sion of these requires additional knowledge of technical illustration.

* The technique for finding the proper angle-ize ellipse for nonisometric surfaces and or dimetric, trimetric, and perspective drawings an be found in detail in the book **Technical llustration** by T. A. Thomas, published by AcGraw-Hill Book Co., 330 W. 42 St., N. Y., I. Y.

The Author

Theodore A. Thomas is professor of technical illustration at El Camino College, El Camino College, Calif. He is instructor in technical illustra-tion at Long Beach State College and educational advisor for Technical Il-lustrators Management Association. He has taught technical illustration, drafting, and blue print reading for eighteen years, and has more than nine years' industrial experience in these subjects. Professor Thomas has given many private lectures on tech-nical illustration.

VISUAL COMMUNICATION

With all our modern ways of making information available, pictures in many cases still can do the best job of telling us what we need to know

by Emil W. Grieshaber

COMMUNICATION, Webster says, is an interchange of thoughts or opinions by conference or other means. It is the ability to interpret these thoughts and opinions, to record them, to add to them, and to pass them along to others that has brought man to his present status. The power to communicate has helped us achieve a technology beyond the dreams of people living only a few years ago. But as this technology has grown it has threatened to outstrip our current methods of communication. We are faced with finding new ways of keeping pace if the growth is to continue.

What we need are devices and methods by which the greatest amount of information can be made available most effectively in the least time.

Man is essentially a sensory creature. He gets his impressions and forms his beliefs and opinions through what he sees, hears, tastes, smells, and feels.

Each generation is left a progressively greater legacy of information to sift, study, and absorb. This legacy reaches back to prehistoric man who left some penetrating glimpses into his thoughts, habits, and beliefs through the pictures he drew on the walls of ancient caves.

Now, with all our modern printing methods and ways of storing words on records and on tape, pictures in many cases still can do a better job of telling us what we want and need to know. Why? Because a great many of our most vivid and enduring sensory impressions come from our eyes.

Studies in retention have shown that the average person remembers about 20 percent of what he hears, 30 to 50 percent of what he sees, and up to 70 percent of what he sees and hears. Carry it one step further, to what he sees, hears, and does, and the figure climbs to the neighborhood of 90 percent.

Obviously, it is often impossible for people actually to do everything they want to learn about. So the next best thing is for them to be shown. And to increase their retention even more, it is to the greatest advantage if they can be shown and told simultaneously. The Chinese had a term for it: "one seeing is worth a hundred tellings." Yet, to say that visual communication is superior to oral communication, per se, would be an untruth. Rather, the two complement one another so that the effectiveness of each is enhanced to a degree it could not reach alone.

Audio-Visual Aids

THE INCREASING need for more effective means of communicating information has resulted in a growing array of modern tools of learning we call audio-visuals. Our impressions of the world around us are made up mostly of sights and sounds. Audio-visuals can bring recorded sights and sounds of one country around the world to a group of people in another, offering them real experiences and giving them the basis for thinking and understanding. Audio-visuals overcome limitations of time, size, and space; they can influence attitudes and show processes which cannot otherwise be seen—and can compel attention. Through audio-visuals, all members of a group can share a joint experience.

Visual communications form the most versatile half of this audio-visual group. Through the use of visual aids the most complex design or intricate formula can be reduced to its simplest components and built back up again step by step to leave a clear understanding of its form. To attempt to do this without the aid of visual illustrations would be laborious and time consuming and in some cases next to impossible.

The most common visual communication aids in use today include flip charts, slidefilms, slides, opaque and overhead projectors, motion pictures, and television.

Each of these devices was designed to convey information in the most graphic way, either through visual means alone or by providing visual stimulus to highlight an oral presentation.

These visual tools are not without limitations, however. In the case of television, cost can rule out its use in many situations. Expense and time involved in preparation of materials is a limiting factor in other mediums as well. Also, for many visual presentations it is necessary to darken the room causing the speaker to lose his rapport with the audience. Again, most visual aid mediums have the drawback of being illusionary. They have, in effect, a "now you see it, now you don't" characteristic.

But the tremendous technological and population advances of the last few years have brought a real, almost tangible challenge to all phases of education, from the elementary or college classroom to the sales training department of a modern business concern.

New ideas, new concepts, and improved methods of teaching are of necessity evolving to meet this challenge in what one might call a planned educational revolution.

Out of this revolution, however, have come programs that at times appear aimed at relegating the classroom teacher to the post of being a mere monitor, or the conductor of a business meeting to a pusher of buttons and switches. The trend has been toward complexity when perhaps it might better have been aimed at simplicity.

What remains to be developed is a machine that can supply the human factor—a machine that can move about, talk, answer questions, and lecture on a rapidly shifting range of subjects while still maintaining audience attention and discipline. Such a device is thus far beyond the range of our present technology.

The Overhead Projector

There are, however, devices with the basic aim of enhancing the value of the human factor in the teaching role. The most versatile of these is the overhead projector. It provides all the advantages of an audio-visual tool for more effective presentations, yet maintains the discussion leader or lecturer as the central figure in complete control.

An increasing necessity of the complex world we live in today is the group meeting, the need to get together to evaluate, to plan, to teach, and to enact. Whether a meeting is effectively serving its purpose usually is determined by how it is conducted. This is where visual communication aids are playing an increasingly important role.

An executive's time is precious, both to his company and to himself. This precious time can be wasted in lengthy, disorganized discussion at a business meeting and the fact that this very thing has happened too many times has helped spark a growing demand for tools to accelerate and simplify the presentation of vital information.

Here is where the overhead projector can play an important role.

The overhead was developed during World War II at the request of the Armed Forces which were faced with the urgent need to teach thousands of raw recruits how to operate and maintain the complex tools of modern war. The device was quickly installed in training camps throughout the country.

The overhead projector is liked by speakers for many reasons. It is easy to operate, projects a large, clear image and there is no need to darken a room to use it.

The projector also is designed so the person using it faces the audience, making it possible to maintain easy eye contact at all times. If he wishes to point out something on the screen, he merely takes a pencil and touches it to the transparency which lies face up and easily readable on the projection surface. The image of the pencil appears like a pointer on the screen behind him.

A list of subjects, figures, or other tabulated information may be discussed a line at a time by placing a sheet of paper over the transparency, drawing it down only enough to reveal each item as it comes under discussion. If a speaker wishes, he can write or draw with grease pencil or pen on the transparency to add new information or elaborate on an illustration.

Like their companions in the visual aid field, the overhead projectors have suffered in the past from limitations of flexibility and convenience.

This problem has now been virtually eliminated with development of a new process whereby transparencies can be made in seconds by merely running a sheet of transparency film and the document from which the transparency is to be made through a dry process copying machine. The image is copied and the transparency ready for projection in seconds.

This has opened a whole new range of uses for the overhead. With a copying machine and overhead projector available, transparencies can be prepared or changes made in a presentation on the spot.

It is advisable, of course, to preprepare visuals illustrating items to be discussed wherever possible, but the new system now makes it possible to change or correct any originals, make new transparencies or add to old ones, make and project transparencies for discussion of on-the-spot information, and make transparencies of the minutes of the meeting as soon as it is over for approval or correction.

With this new flexibility the projector becomes an ideal tool for such things as the Monday morning sales meeting when data arrives from the field in the form of sales reports and related information for review by home office executives.

In the cases of confidential data where only one copy is permitted, a transparency can be made right in the room and shown for discussion by those present, and then destroyed as the meeting adjourns.

Use of the copying machine can do away with the illusionary quality of the visual presentation. Copies of the document from which the transparency was made can be turned out quickly and easily for distribution during or after the meeting.

Talk, it has been said, is cheap, implying that words unaccompanied by action are ineffective. People from childhood on learn to tune in and tune out on parental and teacher lectures, on conversations, on sermons, and even on music while their thoughts wander elsewhere. They can easily lose the train of a speaker's thoughts and when they tune back in they find they don't know what he's talking about. The thread of communication has been broken.

Visual aids are effective tools for keeping attention. Just when listeners might be getting restless, a visual can be shown on a screen, catching attention and getting people back on the track.

Or better still, visuals can be combined to illustrate new points as they arise. People are curious, they like to see things and if they know something new is coming up they will be alert for it.

This way, talk is no longer cheap. Its value has been enhanced to make meetings and class sessions more effective, listeners learn and retain more, and the speaker himself come away with a feeling of greater achievement.

The Author

Dr. Emil W. Grieshaber is a teacher turned scientist who has been a prominent member of the research management team at Minnesota Mining and Manufacturing Company for more than 10 years.

He developed his interest in visual communication aids as an instructor in the Army during World War II and later at the University of Illinois where he taught while continuing studies that led to a doctor's degree in organic chemistry.

Dr. Grieshaber joined the 3M Company in 1951 and currently holds the post of laboratory manager, visual products, for the Duplicating Products Division.

He was the leader of a group of 3M scientists who developed a new visual communications system employing a dry process copying machine and an overhead projector.

IS GRAPHICS MORIBUND?

by Sandor T. Halasz

Many a thing puzzles a European engineer in the U.S.; one of them is the almost complete absence of graphical methods, and the sometimes covert, and quite often overt, hostility toward them. Of course, graphical methods are in the decline in Europe too; it might be said that the ultimate explanation for this lies in the general cultural pattern of current Western civilization. In the U.S., however, this phenomenon has reached unparalleled proportions. I shall try to analyze a few of them.

The most conspicuous feature of American drawing practices is the use of quite cumbersome drafting tables. This may seem trivial; everybody however, who is in a position to make comparisons will admit that to spend eight hours at an almost horizontal drafting board is a real pain in the neck and even more in the back, in the literal sense of the word. In Europe the much more convenient swinging boards are widely used, easily adjustable between vertical and horizontal positions, also up and down. They enable the draftsman sitting on a conventional chair to reach any spot on the board. The equipment need not be something fancy reminiscent of a dentist's chair, with all kinds of hydraulic miracles; cheap and good solutions are available. It is perfectly understandable if those condemned to hunch over the clumsy horizontal boards, now sitting, now standing, now sitting again on their less-than-comfortable stools prefer anything else. This, of course, affects primarily the draftsman, much less the one applying graphical engineering methods; nevertheless it may have a larger effect on the general attitude toward drafting than commonly realized.

In the introductory article to graphic methods, the author of a justly esteemed text on engineering mechanics thus apologizes for his treating them: "In most cases, the care and time required to obtain results graphically are much greater than is required for the same results analytically. Graphic results, moreover, are frequently not as accurate as the analytical.

"In spite of these objections, graphic methods are still used . . ." A brief explanation tells why.

To check the statement about the "care and time," I have solved a few elementary problems in mechanics both analytically and graphically. (The latter methods are usually omitted from current engineering curricula.) Here are the results:

a/ The forces in all members of a coplanar truss. Time required:
Analytically: 22 minutes;
Graphically: 13 minutes.

b/ Find the principal stresses at a point in a stressed body. Time required:
Analytically: 3 minutes;
Graphically: 2 minutes.

c/ Find the reactions and the maximum bending moment on a simply supported beam:
Analytically: 5 minutes;
Graphically: 6 minutes.

As for accuracy, the largest deviation of the graphic results from the analytical ones (which I regarded as "accurate") was 1.5%. When doing this check I did not use any special drafting equipment; I did it on my desk, without fastening my paper, with two triangles, a scale, and a regular mechanical pencil.

The obvious but often neglected fact that the accuracy of any engineering calculation, graphical or otherwise, depends to the largest extent on the reliability of the initial data makes claims of minute accuracy illusive in 8 out of 10 cases. We can safely conclude that in a large number of cases the objections about "care and time" are nothing but rationalizations of other, perhaps more concealed, reasons.

Another fact, which is a result as well as a reason for the outlined attitude, is that many graphical methods are now forgotten. You can get a degree in mechanical engineering these days without having ever heard of the Maxwell diagram or the funicular polygon, to mention two only. Mohr's elegant solution for the elastic line and deflection of a tapered or shouldered shaft is almost entirely forgotten in its original form; it survives as a cumbersome semi-graphical method called modified moment-area method. You can get a doctorate in kinematics without knowing Zeuner's circle. The point is that these techniques are useful even for him who never actually uses them. They give an insight and lucidity never obtained by analytical methods. It is safe to state that by doing one graphical differentiation or integration you will understand calculus better than after months of lectures. It is interesting to note that in conversation most foes of graphics admit this significant merit of graphics. But if you do not know a method you will not use it.

It must also be admitted in all fairness that many graphical techniques, brain children of perfectionist nineteenth century thinking, did not deserve survival. Procedures to find the centriod of an area graphically, say, or its moment of inertia did, in my opinion, more harm than good to the cause of graphics.

One serious drawback of graphic methods should not be kept secret: it is more than easy to forget them. Do not use one for a couple of years and you will recall all details and shortcuts after considerable guesswork and some errors only. In cases like this, it is much easier to look up a few equations in an engineering handbook.

But if you keep them fresh in your memory they will be more than grateful. They will provide you with clearer insight and a lucid understanding rendered by no other method and in many cases also with an automatic check of your work and a source of satisfaction and beauty.

The Author

Sandor T. Halasz is an instructor of Applied Mechanics at New York University. He was formerly with the Department of Drafting, City College of New York.

Application of Graphics to Engineering Design Problems

Some challenging examples of how graphics are used in the practical solution of engineering problems

by P. G. Belitsos

COMPOSITE FORM TOLERANCING

Part II of a Series

This paper was presented at the Summer Conference on Graphics in Scientific Engineering held at the University of Detroit, July 18, 1960 by the National Science Foundation.

IN THE drawing of the turbine casing assembly shown last month, the positional relationship of the series of diameters constructed around the common axis were controlled without the use of a concentricity note. Instead the use of composite form tolerancing was introduced. This is the most advanced practice used in the aero-space industry for controlling the functional relationship of multiple surfaces which are constructed around or at right angles to a common datum axis. This may involve parts or assemblies with a single common axis such as that shown in Fig. 1 of this section or components with more than one axis such as shown in Fig. 2. The principles of composite form control were first used by some aircraft engine companies and more recently have been fully developed by the Aero-Space Drafting Committee of SAE as follows.

1. Common Datum Axis. It is first necessary to establish a common datum axis about which the features of the part are to be related. As previously pointed out, this may be established by two cylindrical or conical surfaces having a substantial axial separation, as shown in Fig. 3, or a cylindrical surface and a plane which is perpendicular to it. In certain cases the common axis may be established by one single cylindrical surface provided it is of sufficient length.

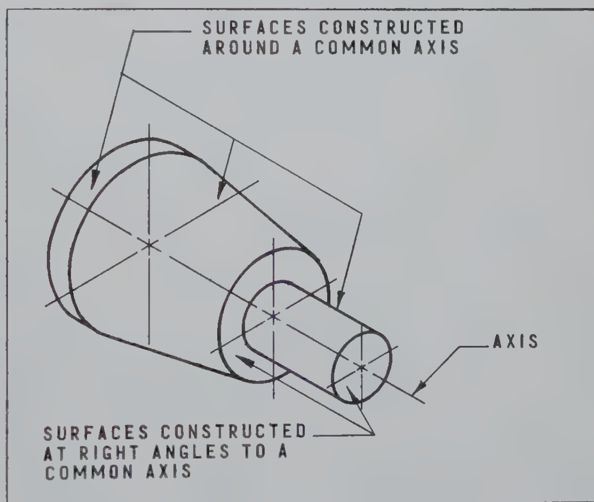


FIG. I SINGLE COMMON AXIS

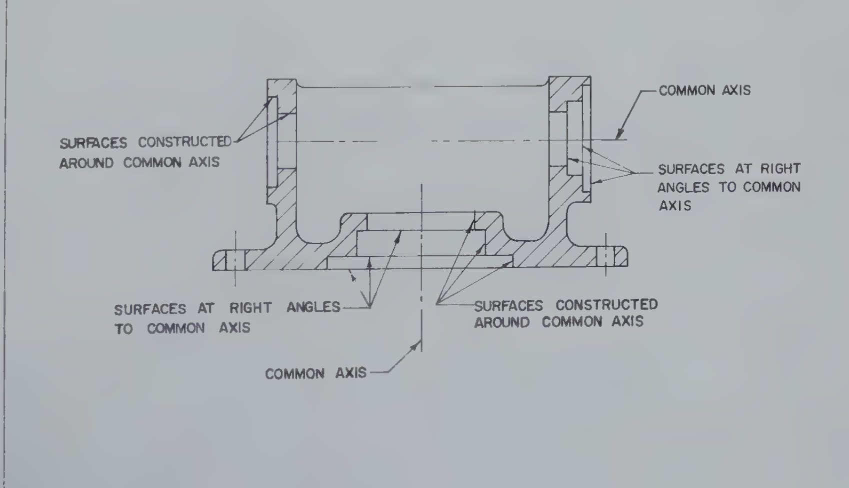
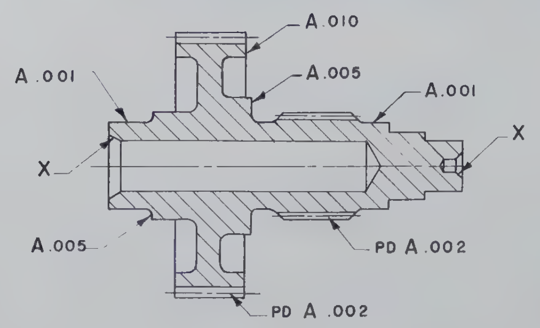
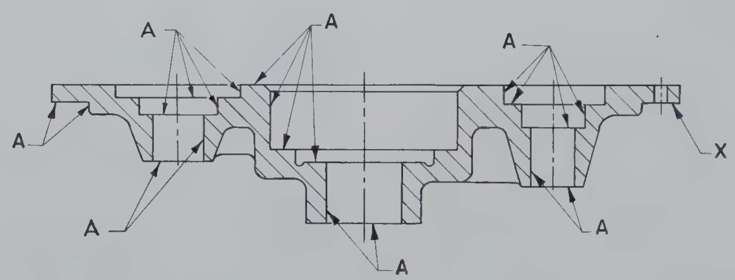


FIG. 2 MULTIPLE COMMON AXES



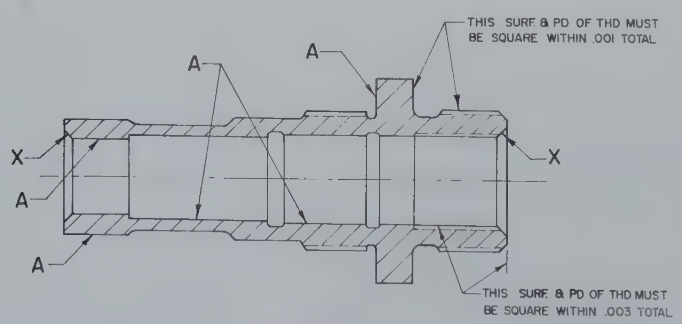
WHEN MOUNTED ON SURFACES X, THE SURFACES A MUST BE WITHIN FIR. SPECIFIED

FIG. 3 SURFACES ABOUT A COMMON AXIS



WHEN MOUNTED ON SURFACE X, THE SURFACES A CONSTRUCTED AROUND OR AT RIGHT ANGLES TO A COMMON AXIS MUST BE WITHIN .001 FIR.

FIG. 4 APPLICATION TO MULTIPLE AXES



WHEN MOUNTED ON SURFACES X THE SURFACES A MUST BE WITHIN .002 FIR

FIG. 5 LOCAL CONTROL NOTES

2. Basic Control Notes. Each surface that is to have a controlled relationship to the common axis is identified by a suitable designating letter which refers to a general note. This note controls the concentricity, parallelism, and squareness of the specified surfaces to each other when the part is mounted on the datum surface or surfaces. This note also controls the circularity, flatness, parallelism, and straightness of each of the specified surfaces.

For most parts where the related surfaces to be controlled have a single common axis a general note such as that shown in Fig. 3 is used: *When mounted on surface(s) X, the surfaces A must be within the FIR. specified.*

For more complex parts which have groups of surfaces to be controlled, where each group has a different common axis, the general note to be used is as shown in Fig. 4: *When mounted on surface(s) X the surfaces A constructed around or at right angles to a common axis must be within the FIR. specified.* This figure illustrates the application of this note to a part with multiple common axes. With the part mounted on a large flat surface, the required form control is specified for each of the surfaces constructed around or at right angles to each of the three axes shown.

Where form requirements of features have no functional relation to a common axis, they may be expressed by local notes relating surfaces directly to each other as in Fig. 5.

3. Control of Individual Surfaces. In order that the allowable deviation from the geometric relationship of surfaces be properly controlled, it may be necessary to control the geometric form of individual surfaces. This control is specified when greater accuracy is required than that provided by the size dimension of the individual surfaces or by the

composite form control note. A suitable local note or general note is then used with a suitable designating letter identifying those surfaces which require this control. The following note shown in Fig. 6 is typical for this purpose: *Surface(s) specified by X must be circular, parallel, and straight within .0002 FIR.*

This type of note is used where it is necessary to control the circularity, parallelism, and straightness of an individual diameter more accurately than the diametral tolerance or basic composite form control note limit. Fig. 6 shows an example of two surfaces separately controlled in this manner.

If the individual form characteristics of the surfaces required control to a different degree of accuracy the note would be specified as follows: *Surface(s) specified by X must be circular within .XXXX FIR., parallel with .XXXX FIR., and straight within .XXXX FIR.*

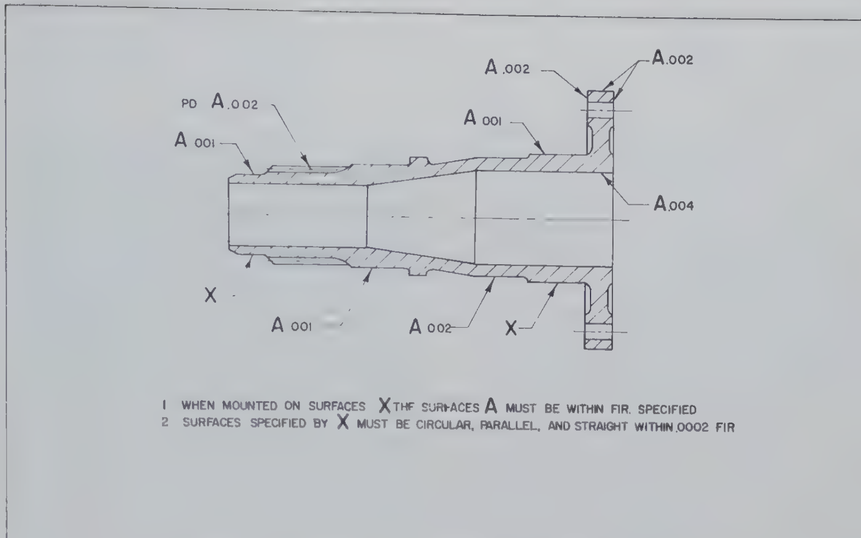


FIG. 6 CONTROL OF INDIVIDUAL SURFACES

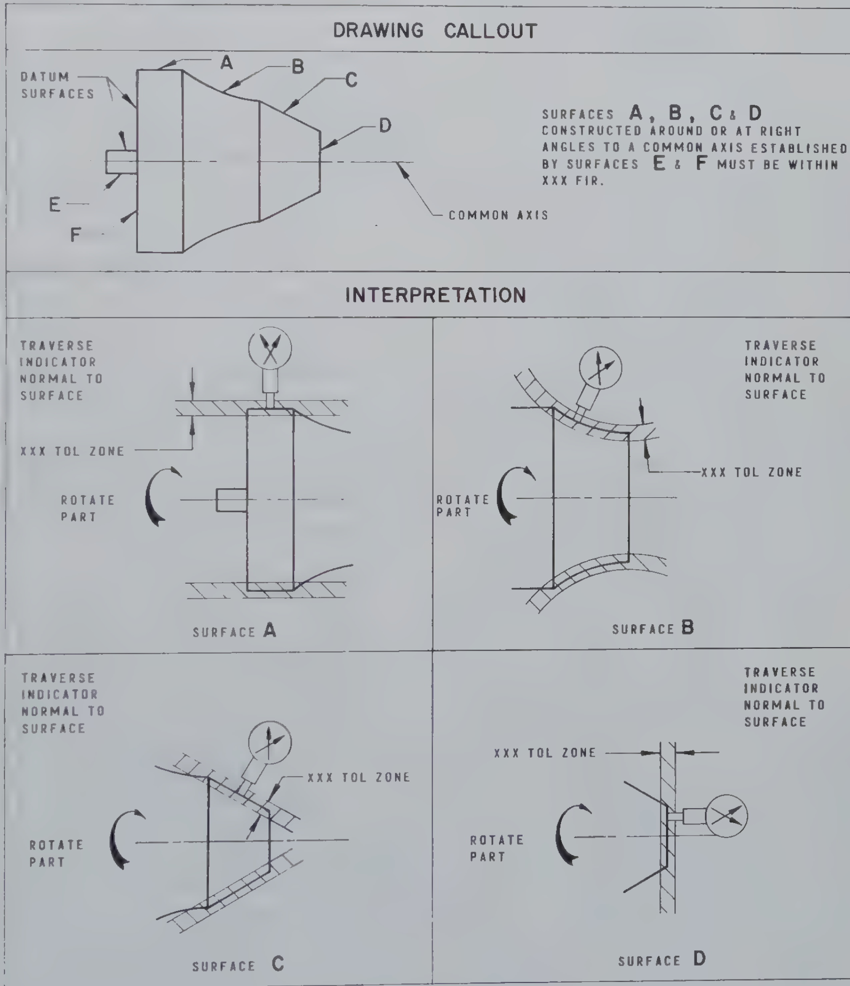


FIG. 7 SURFACE RUN-OUT

Interpretation of Composite Form Tolerance Notes

That portion of the note which refers to "*surfaces specified by A*" or "*surfaces specified by X*" refers to the designated surfaces in their entirety rather than to arbitrary points or lines on these surfaces. When these notes are applied to special features such as threads, splines, and gears, the pitch diameter will be considered as a cylindrical surface. In the case of a bevel gear or tapered threads this will be a conical surface.

That portion of the note which refers to the "*surfaces constructed around or at right angles to a common axis*" as shown in Fig. 7 relates to and identifies the surfaces of revolution whose circular elements are constructed concentric to the common datum axis. These surfaces of revolution may be constructed around or at right angles to the axis and they may be cylindrical, conical, or flat as shown in Fig. 7.

The errors that can exist in a surface of revolution are eccentricity, out of roundness, excessive taper of cylindrical or conical surfaces, and deviations in the flatness and squareness of surfaces at right angles to the axis. All of these errors can be controlled by specifying a surface runout requirement.

Thus as pointed out previously, surface runout provides a practical method for specifying the control of the geometric form of surfaces of revolution. Surface runout can be specified and measured directly as a full indication reading (FIR) and it

accumulates the errors of several geometric categories into one value. This is covered by that portion of the note which reads *"within .XXX FIR."* Fig. 8(A) illustrates surface runout that may result from out-of-roundness or eccentricity. The full indicator reading may be attributed to all out-of-roundness, all eccentricity, or a combination of both. Fig. 8(B) illustrates the surface runout or full indicator reading of surfaces constructed at right angles to the axis.

Since the surface runout requirement, as expressed by the full indicator reading, indicates accumulation of several types of variation in geometric form, critical surfaces may have out-of-roundness, or flatness specified in addition to the requirement for surface runout.

Eccentricity requirements should be specified only when they are important because eccentricity cannot be measured directly and its determination is difficult. When specified, it should be given as the maximum allowable eccentricity between two axes and not as a full indicator reading. It is important to understand this distinction because the full indicator reading is an indication of surface runout which is a combination of eccentricity and out-of-roundness.

Returning once again to Fig. 6, that portion of the note which reads *"when mounted on surface(s) X"* means that all surfaces designated A on a common axis including X surface or surfaces must be individually within the full indicator reading specified when so mounted. In other words the A limit of the X surface or surfaces must not be added to the A limit of any other surface and applied as a total tolerance for inspection. This also applies where the part is mounted on machining centers, in which case the X surfaces are the conically shaped bearing surfaces of the centers.

Any individual surface on which an A value is specified without an X value and is within the X value (full indicator reading) specified, is simultaneously controlled for the conditions of circularity, flatness, parallelism, and straightness within the limits of that A value or within the dimensional tolerance of the surface, whichever is less.

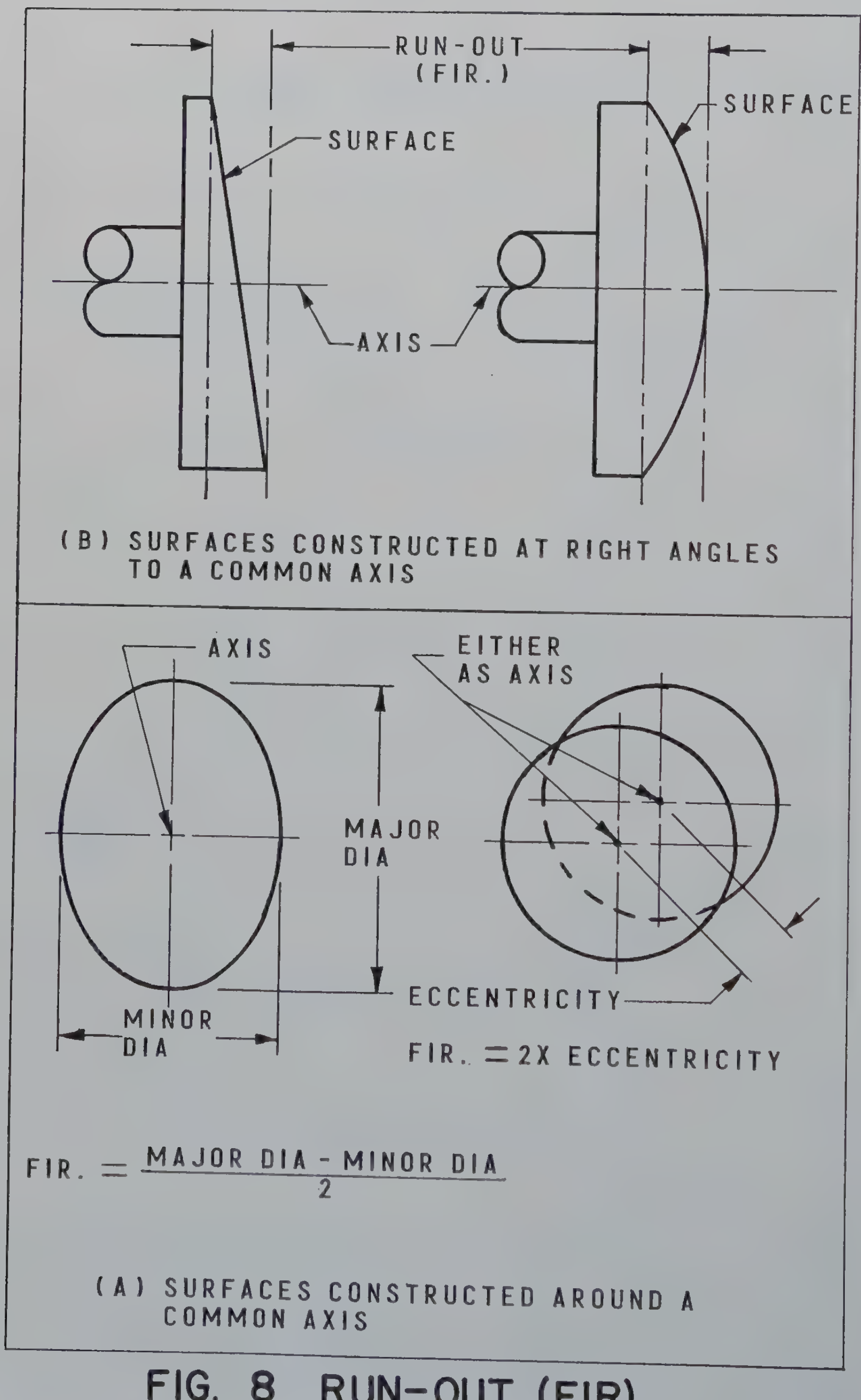
Any surface identified as X which is within the X value (full indicator reading) specified, is simultaneously controlled for the conditions of circularity, parallelism, and straightness within the limits of that X value.

Any two surfaces of a part which are specified by an A and are individually within their indicated A value (full indicator reading), are simultaneously controlled for the conditions of concentricity, squareness, and parallelism within the sum of their specified A values.

The term "parallel" applying to individual surfaces as controlled by use of the composite form control notes, means that opposite elements of a cylindrical surface are parallel and provides a control against excessive taper. The term "cylindrical surface" applies only where a single diametral dimension is indicated for the entire length of the surface.

Having now completed the discussion of the control of free state variation and composite form tolerancing as it applies to rigid and nonrigid structures, we will turn our attention next month to the application of engineering graphics to the design of multiplane rigid metal tubes.

To Be Continued



(B) SURFACES CONSTRUCTED AT RIGHT ANGLES TO A COMMON AXIS

(A) SURFACES CONSTRUCTED AROUND A COMMON AXIS

FIG. 8 RUN-OUT (FIR)

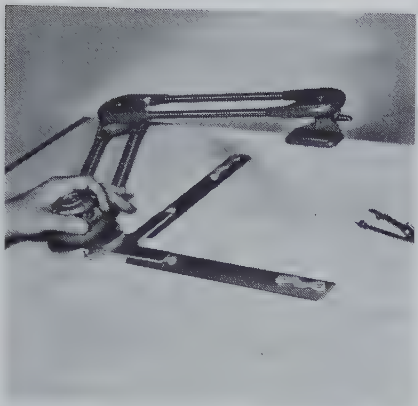
High Intensity Lamp

What has been described as the first really new innovation in lighting in twenty years is now on the market. An incandescent 10-inch-high, space-saving, variable intensity, lightweight lamp resting on a base only slightly larger than a pack of cigarettes has been introduced by Tensor Electric Development Co., Inc., 1873-1877 Eastern Parkway, Brooklyn 33, N. Y. Designed particularly for those doing really close work, the lamp not only gives excellent light, but also has important spacesaving features. The Tensor Precision Work Lamp Model 5900 has a miniature reflector with a diameter of only 2½" and a five-position switch so the lamp may be used at different intensities using an ordinary G.E. 6-volt bayonet-type bulb. An extra feature: an electrical outlet which can be used for meters, small electrical tools, appliances, and other apparatus.

Reader-Printer

The Recordak Reader-Printer, a microfilm reader which makes paper prints of documents on microfilm with push-button ease, has been announced by Recordak Corp., Subsidiary of Eastman Kodak Co., 415 Madison Ave., New York 17, N. Y. The new unit operates with 16 mm. or 35 mm. film in roll form, in aperture cards, or in card-size film jackets. It is fully automatic; operator merely pushes a button to make a photo-print of the microfilm record projected on the screen. Paper and chemical cost is about 9¢ a print. Images are enlarged up to clear and sharp readability on the self-contained 11- by 11-inch screen. A paper copy can be ready for use within 45 seconds. A variety of lenses are available to provide prints up to 87% of original size, regardless of the reduction ratio at which the documents are microfilmed. No darkdoom is required.

(For additional information regarding the new products described here, contact the manufacturer directly. Complete addresses are included.)



Drafting Machine

A new compact, desk and table-top drafting machine is the latest product of Keuffel & Esser Co., Third and Adams Sts., Hoboken, N. J. Called Paragon Jr., the new unit is designed for the draftsman or design engineer who needs a board for part-time office or home use. It combines the drawing capabilities of a T-square, straightedge, triangle, scale, and protractor and features controls permitting one-hand operation. A simple bracket assembly facilitates temporary or permanent mounting on almost any desk, board, or table. It operates efficiently on any drawing board inclined at any angle up to 20° and will accept any scales with standard chuck plates.

Graphing Instrument

A versatile new graphic instrument called Alsrule converts a plain sheet of paper into a custom plot with linear or logarithmic scales of any length, number of cycles, scale modulus, or configuration (rectangular, polar, etc.). Eliminating the need for a costly supply of graph papers with assorted sizes and cycles, the plotting scale is a simple plastic chart, measuring 4" by 8", with a variety of scales provided on both sides. Twelve log cycles and three linear scales are arranged around the periphery for direct plotting use. In addition, two triangular charts, one linear and one logarithmic, provide an infinity of precision-divided scales of varying moduli. Further information is available from Technical Marketing Associates, Inc., 33 Sudbury Rd., Concord, Mass.

Erasing Machine Holder

A new tool designed to make an electric erasing machine available for ready use at all times with the least effort and time required by the draftsman is now on the market. An adjustable clamping device makes the tool adaptable to any thickness of table, completely adjustable in height and direction. The holder provides continuous control of the erasing machine by means of a balanced counterweight, permits easy access to all parts of the drafting board. For further information write either manufacturer G. P. Widener, 4634 Weir St., Corpus Christi, Texas, or C & S Steel and Instrument Co., Inc., Fort Worth, Texas.

Presensitized Coating

A new method of preparing tint negatives or positives for maps, drawings, and art work employs a material called Striprite. The presensitized red coating on a thin, transparent plastic base is actinically opaque; the plastic base is a dimensionally stable polyester. Striprite eliminates time-consuming drafting, provides excellent registration for plate-making or any photographic operation. The results give true fidelity to the original positive, last indefinitely. A Striprite trial kit is available free by writing Direct Reproduction Corp., 811 Union St., Brooklyn 15, N. Y.

Deletion Fluid

A chemical which removes unwanted images from 3M brand smooth, presensitized offset plates, has been introduced by Minnesota Mining and Manufacturing Co., 900 Bush Ave., St. Paul 6, Minn. The fluid, called 3M Brand Deletion Fluid, is designed as a companion product to the recently introduced 3M Brand Plate Tusche, an addition fluid. Both may be applied while the plate is on the press, reducing press downtime and plate remakes. The company says the deletion fluid is faster than honing or other mechanical methods of removing images and does not leave abrasive particles which might foul inking or dampening systems.

New Literature

Drafting Film Test Results are described in an eight-page, two-color brochure now available from Keuffel & Esser Co., Third and Adams Sts., Hoboken, N. J. The two years of tests were made on Herculene drafting film to ascertain strength, erasure, reproduction, stain, and durability characteristics. Also included in the report: how the surface of the film takes pencil, type, and ink. The brochure also includes a brief history of drafting film from 1952 to the present, and recommended uses for Herculene.

A Unique Filing Device of special interest to engineers and others who need to file engineering drawings, blue prints, and maps is described in a flyer from the Dancer Stikfile Co., P.O. Box 10221, Houston 18, Texas. The literature describes the open-type steel filing cabinet, which utilizes a special dowel system on sliding tracks. Illustrations, prices, and specifications are included. The manufacturer will send flyer free on request—also a general catalog showing the Stikfile complete line.

Aristo Coordinatographs are the subject of a new catalog issued by Unitech Corp., 50 Colfax Ave., Clifton, N. J. The catalog pictures and describes ten improved models in the Aristo line, plus a variety of new accessories which have not previously been shown.

An Encyclopedia of Drawing Materials commemorates the 60th anniversary of Nobema Products Corp., 141 Greene St., New York 12, N. Y. The sixteenth edition of the firm's catalog is a 464-page listing of artist's supplies, alphabetically as well as numerically indexed for easy reference. The catalog is clearly illustrated, and retail prices are listed for each item. Free catalogs available to dealers on request to the company.

Anhydrous Ammonia System is the subject of a four-page booklet recently issued by Copymation, Inc., 5650 North Western Ave., Chicago 45, Ill. The manufacturer claims its Ammo-Matic systems reduce ammonia costs up to 60%, assure improved print development, effect substantial savings in time, and bring new efficiency to diazo printmaking.

Mico/Tape Catalog offers a large selection of colors and patterns in tapes for charting and preparing graphs, includes also such diverse products as title and revision blocks, product identification and instructional labels and decals, government specification marking tapes and labels, drafting film and correction papers. Mico/Tape Inc., 6551 Sunset Blvd., Los Angeles 28, Calif., claims this is the most complete and concise directory of tapes and decals available. The 16-page catalog is available free on request.

(Copies of the literature reviewed can be obtained directly from the manufacturer or publisher. Complete addresses are included.)

The Book Shelf

SHEET METAL DRAFTING, by Melvin L. Betterley. McGraw-Hill Company, Inc., New York, 1961 ($6.50). Review by Irwin Wladaver.

PROFESSOR Betterley's new book, *Sheet Metal Drafting*, has much to recommend it to sheet metal draftsmen and to students interested in that important field. The book features large illustrations of a great array of developments. Chapter 9 starts the treatment of developments with a fairly simple right circular cylinder. Chapter 12 ends with a warped cone elbow and with a sample intersection of a right circular cone and a warped cone.

In between, you can find virtually any surface you can think of. I'll name a comparatively small variety of items that Betterley deals with:

Under parallel line developments, Chapter 9:
- Two-piece and three-piece elbows, with all necessary definitions
- Compound-curved duct elbow
- Compound-curved transitional duct elbow
- Offset design factors
- Compound offsets
- Plotting of intersections
- Round-to-oblong transition
- Ogee eave gutter

Under radial line development, Chapter 10:
- Cone frustums
- Truncated right circular cones
- Oblique cones
- Conical reducing elbow
- The cutting-sphere method
- Approximate development of "nondevelopable" surfaces
- Right and oblique pyramids

Chapter 11 is devoted to triangulation, a powerful, almost all-purpose, weapon in the hands of a sheet metal draftsman. An understanding of triangulation puts a sheet metal draftsman into the position of never being at a loss for the development of a warped cone, a square-to-round transition, a round-to-oblong or -elliptical transition, a 90° rectangular-to-round transition, or virtually anything else imaginable.

In Chapter 12, Betterley displays many "combination" problems, such as a three-piece reducing elbow with all the reduction in the center piece, a cone frustum with horizontal take-off, and other unexpected variations.

The first eight chapters are introductory material for the student draftsman. They include instruments and materials; instrument techniques; lettering; geometric constructions, largely limited to what's needed in sheet metal drafting; basic orthographic projection; auxiliary views; and rotation. A beginner needs this material; an experienced board-man would naturally skip it. The final chapter is on dimensioning and once again it is limited generally to elements in sheet metal drawing.

I have a couple of suggestions to offer to my friend, Professor Betterley, for consideration in a subsequent edition. First, I think that a freer use of numbers in some of his illustrations would make them easier to follow for a student who has to study without a teacher. Of course the figures are generally pretty big, so this may not be a serious complaint.

Second, I know it's wrong for me to complain about a topic that Betterley has purposely omitted. In his Preface, Betterley states his reason for omitting certain specific matters, among them processes, seams, and allowances. Nevertheless, I feel that a student of sheet metal drafting should not be spared the obligation of getting acquainted with such essential information as seams and joints. I think Betterley should devote a few paragraphs to the various kinds of edges and hemming, and to the different methods of seaming, and even to some discussion of welding applications. Of course these things come up on the job, but they should be available in the book for reference.

Many well known industrial firms have provided good pictures of developed surfaces in actual use. This kind of thing is good motivational material. Students apply themselves more readily when they know they aren't toying with professorial armchair stuff. The pictures prove that the work is real.

The problems at the end of each chapter are very good. They have been carefully, thoughtfully selected. I feel that a student who has worked these problems need not fear any development problem he might be faced with on his new job. He will have developed command of a body of theory and he will have had the right kind of practice in applying the theory. He will be free of rule-of-thumb solutions so prevalent in layout shops, solutions that work well enough for mama-papa stuff but fail when anything out of the ordinary pops up. It will be good for him to have a copy of Betterley within easy reach.

the publisher's board

Reproduction Survey

MOST REPRODUCTION DEPARTMENTS are fairly happy with their present equipment but nevertheless are searching for new equipment to do the job better, faster, and cheaper. This is one of the points brought out in a survey recently conducted by *Graphic Science* which solicited the opinions of readers on the effectiveness and quality of their reproduction equipment and supplies.

Of the 166 respondents to the survey, nearly 72% were satisfied with their present equipment. Approximately 57% of the respondents plan to investigate other reproduction methods, with microfilm being by far the most popular system under scrutiny. Electrostatic and other dry developing systems are the second busiest areas of investigation. The advantages of offset printing equipment are being looked at by several, while eight said they were willing to look at anything and everything.

A great majority of the respondents are seeking greater versatility in reproduction equipment—83% of them say they must copy material other than engineering drawings on their equipment. More than 43% of the respondents needed two or more pieces of reproduction equipment to give them the necessary versatility or volume.

While most of those who replied to the survey indicated satisfaction with their present equipment, they came forth with a barrage of complaints when asked what they disliked about it. Those most frequently noted were either that the equipment was not fast enough or that the ammonia fumes were annoying. Other sources of unhappiness were: poor print separation, difficulty and frequency of maintenance, and poor print quality. One respondent said we did not allow enough space on the questionnaire to list his complaints, while eight others broke down and admitted that new equipment might solve most of their problems.

When queried on the capacity of their present equipment, about 70% replied they were using 42" machines and were quite happy with this size. Only a few wanted larger equipment. About 15% had machines of greater capacity and about 15% with less capacity. Respondents with smaller machines were about equally divided between being satisfied and wanting larger equipment.

When asked what added benefits they would like to receive from their reproduction equipment, the respondents gave the most votes to greater printing speed. Others wanted reflex printing capabilities, better lasting intermediates, easier maintenance and cleaning, and better print separation.

Only 43% of the respondents answered when asked who specified the purchase of new reproduction equipment in their company. By far the greatest number of replies stated that this was the responsibility of the chief draftsman or drafting supervisor. Chief engineers were not far behind in number of mentions. Owners and general managers were listed most frequently in connection with independent reproduction shops. Other buyers included: managers of engineering services, design supervisors, plant engineers, office managers, and purchasing agents.

About 65% reported that their present equipment used a dry developing system. Ten said they had equipment with both moist and dry systems. Approximately 66% use intermediates for correcting drawings.

Among the reasons given for the selection of their present equipment, purchase price, high speed, ease of operation, and ease of maintenance were outstanding. Ammonia odor problems seemed to be as much of a deciding factor as print quality. Others bought because they had had previous experience with the equipment or were given a recommendation by "the man who owns one."

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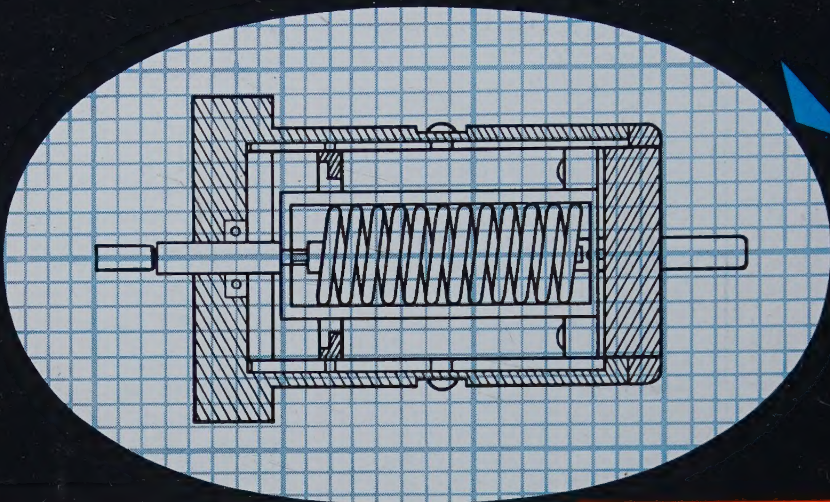

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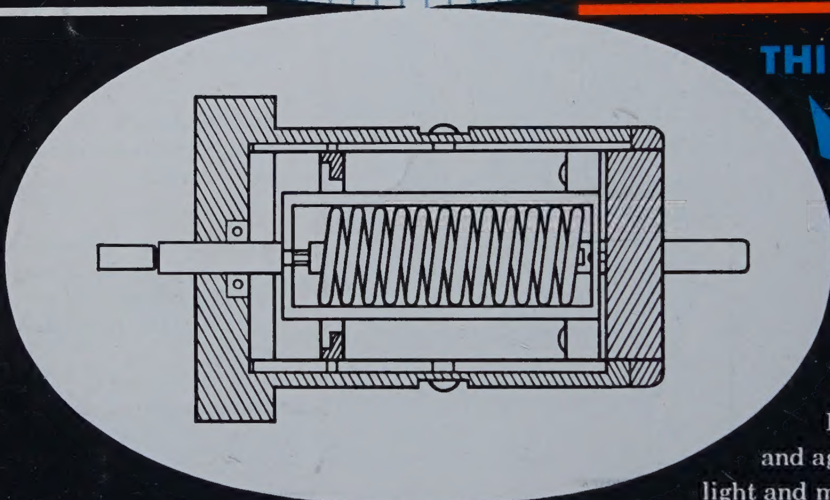

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